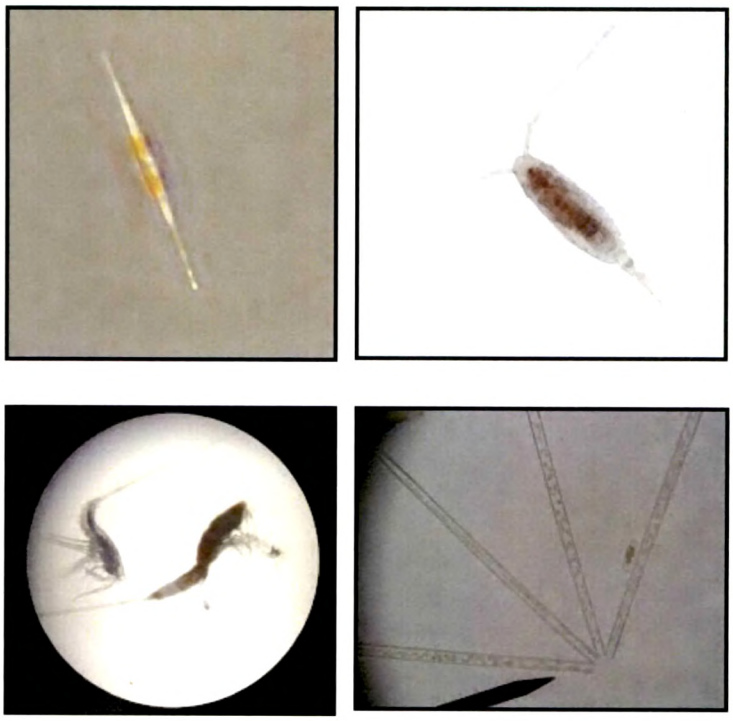
H.T. HANSA MEHTA LIBRARY
M. S. University of Baroda
P/Th
12816

"ECOLOGICAL ASSESSMENT OF NORTHERN COAST OF GULF OF KACHCHH WITH SPECIAL REFERENCE TO PLANKTONIC FORMS"



Thesis submitted to

The Maharaja Sayajirao University of Baroda

for the award of

Doctor of Philosophy in Zoology

Mr. Hitesh K. Kardani

Department of Zoology, Faculty of Science,

The Maharaja Sayajirao University of Baroda,

Vadodara – 390 002, INDIA

December 2011

Phytoplankton is very good indicator to assess the environmental condition of any water bodies marine or freshwater, coastal or pelagic, lotic or lentic. Through their consumption and processing of phytoplankton and other food sources, zooplankton play a role in aquatic food webs, as a resource for consumers on higher trophic levels (including fish), and as a conduit for packaging the organic material in the biological pump. Since they are typically small, zooplankton can respond rapidly to increases in phytoplankton abundance for instance, during the spring bloom. Zooplankton can also act as disease reservoir. They have been found to house the bacterium *Vibrio cholerae*, which causes cholera, by allowing the cholera vibrios to attach to their chitinous exoskeletons.

The interaction of physical and biological processes is extremely important in structuring the biological communities in all marine ecosystems. In the ocean, physical influences are particularly important. All marine organisms are affected to some extent by the movement and thermal properties of ocean currents, but planktonic plants and animals are most closely coupled to the physical environment (Daly, K.L., 1993).

Among nutrients, nitrogen (N) and phosphorous (P) commonly referred as limiting nutrients (Neill, 2005), support the growth of phytoplankton to establish a suitable pelagic food web (Hilmer and Bate, 1990; Adams and Bate, 1999). Besides the availability of nutrients, the physical variables such as flushing rate, salinity and turbidity also largely influence the distribution and abundance of plankton communities (McLusky, 1971; Cleorn, 1987; Ferreira *et al.*, 2005,).

The Arabian Sea is considered as one of the highest productive sea in the world (Qasim, 1977). Generally dissolved oxygen levels are higher during monsoon due to heavy rainfall and the result of freshwater mixing (Zingde *et al.*, 1985; Ramaraju *et al.*, 1987; Mitra *et al.*, 1990; Nandan and Azis 1993; Rajasegar 2003) De Souza and Gupta (1986) and Zingde *et al.* (1987) have

attributed seasonal variations in dissolved oxygen mainly to the freshwater influx and terrigenous impact of sediments.

In present investigation, benthic and pelagic diversity at 03 stations located in 120 km coastal stretch of Kachchh district was investigated. The biotopes studied included Intertidal, Subtidal and Pelagic (zooplankton and phytoplankton) habitats. Besides, nine crucial water quality parameters governing the biological components of these ecosystems were also studied. Seasonal shift, density, diversity, composition and distribution of faunal components were analyzed from the monthly data grouped seasonally. This study was carried from June 2007 to May 2009.

Present study is carried out at three stations located on the northern Gulf of Kutch namely Mundra, Mandvi and Sanghi. These three stations are selected on the basis of their different coastal characteristics. Mundra coast is dissected with creek systems forming extensive mudflats. Mundra coast is luxuriated lined with mangroves. Mandvi coast is characterized by sandy beaches, sand dunes and partially rocky outcomes. Sanghi creek is the one of the longest incursion in the Gulf of Kachchh. Sanghi study site is also characterized by rich mangrove vegetation in nearby vicinity. It experiences the coldest weather in Gujarat during winter.

In total, 88 species of phytoplankton in 45 genera/groups were recorded under four major group namely pennate and centric diatoms, dinoflagellates and cynobacteria. Centric diatoms were the dominant groups in the phytoplankton of the study stations. Mundra recorded higher species richness followed by Sanghi while species richness at Mandvi was comparatively poorer.

Season-wise, species composition was richer during summer during first year, but during second year, monsoon and winter recorded higher species composition of 73. Group wise composition showed diatoms (both centric and

pennate) were more dominant and dinoflagellates were comparatively less dominant during all the seasons in both the years.

Only few genera like *Biddulphia, Ceratium, Chaetoceros, Coscinodiscus, Nitzschia, Pleurosigma* and *Rhizosolenia* were dominant in terms of number of species in all the stations. Overall species distribution showed that out of 88 species, 39 species (44.32%) had wider temporal distribution and they were recorded in all the three seasons. Phytoplankton density varied from 334/L to 1351/L. Average density across seasons was higher at Mundra (902 cells/L) and Sanghi (860 cells/L) while it was lesser at Mandvi. Shannon-Wiener diversity indices values for phytoplankton ranged from 2.36 to 3.84. Station wise, Mundra recorded highest average diversity value of 3.35 whereas diversity values for Mandvi (3.1) and Sanghi (3.1) were almost same. In general, phytoplanktonic communities were floristically better at Sanghi and Mundra than at Mandvi.

Composition of zooplankton in the three study stations was mainly contributed by copepods, decopods and fishes and polychaetes larval forms. A total of 47 groups in 11 broader taxa were recorded in three stations. Sanghi and Mundra had better group/taxa representation than Mandvi as evidenced by higher number of groups in the earlier two stations. Copepods constituted the major group followed by decapods. Number of taxa and groups were higher in all stations during monsoon months than winter and summer. Mundra and Sanghi recorded more number of groups and taxa in all seasons than Mandvi. Out of the 47 taxa recorded during the entire study, 17 taxa had wider temporal distribution. Density values ranged from 209 to 1048/m^3 with maximum values recorded during monsoon followed by winter. Calanoid copepods contributed predominantly to the faunal density in the zooplankton. Shannon-wiener diversity indices values ranged from 3.16 to 3.47 and diversity values fluctuated only moderately among seasons and stations. Evenness values ranged from 0.6282 to 0.893 in all stations and seasons showing season-wise, groups and taxa were not distributed

uniformly. Presence or absence of mangrove ecosystem in the vicinity seems to have a significant influence on the faunal components of these study stations (Viswanathan et al., 2011).

In the three stations, 42 groups of subtidal fauna were recorded constituted by 13 groups of polychaetes, 11 groups of gastropods, 10 groups of bivalves, 6 groups of crustaceans and two groups under the category miscellaneous. Number of groups was more during monsoon followed by winter at Sanghi and Mundra. Polychaetes were the dominant group in all the seasons and stations. However, percentage wise density revealed crustacean dominance, contributing 78% of the total density. Similar to intertidal realm, a significant spatial variation could be observed in the subtidal faunal composition also. Eleven forms recorded at Mundra and Mandvi were absent at Sanghi. Lowest and highest Shannon (H') diversity index value of 1.507 and 2.031 was recorded at Mundra during summer and winter. Dominance values across stations and seasons ranged from 0.215 to 0.431 showing subtidal faunal groups were more equally distributed with least dominance of some groups. Subtidal benthic faunal density and diversity recorded in the present three study stations appeared comparable with those of other coastal stretches of west coast.

Analysis of 12 water quality parameters in three seasons in Sanghi creek surface waters indicated that the water quality is pristine and concentrations of parameters like nutrients (phosphate and nitrate were not critical and posed no threat to the water quality or biota. However, more than normal values of salinity and turbidity were recorded which might be due to the combination of anthropogenic and natural factors. Recorded values of dissolved was well within the safer limits and did not indicate any stressed condition of the water column. Nutrients like nitrate and phosphate recorded in the present study was much lower than other earlier recorded values. In general, the studied parameters in water quality were not critical and well

SMT. HANSA MEHTA LIBRARY

within the prescribed range and did not show any stressful condition in water quality.

The pristine coastal waters are saturated with dissolved oxygen and this is so in the present study also. DO in all three stations ranged from 3.03 mg/L to 7.65 mg/L with an average of 4.78 mg/L.

The surface water temperature was found in the range of 17^0C to 33^0C. As a normal rules temperature was lower during winter months and higher during summer months. The lowest temperature was recorded at Sanghi and highest temperature is recorded at Mundra.

Hydrogen ion (pH) concentration in all three sites was slightly to moderately alkaline ranging from 7.3 to 8.35 with a mean value of 7.95. Maximum values were recorded at Sanghi and minimum at Mundra.

Water salinity ranged from 34-42 ‰ with a mean of 37.18‰. The highest salinity was recorded at Sanghi due to lower freshwater input throughout year except monsoon and high aridity.

Turbidity values ranged from 10.2 to 75 NTU with an average value of 24.76 NTU. The maximum turbidity was observed at Mandvi due to its open coast and wave action. While higher values at Mundra and Sanghi are due nearby vicinity of Mangrove and high tidal influence in Gulf of Kachchh.

Total suspended solids (TSS) values were ranged from 685 mg/L to 2345 mg/L. generally higher turbidity and suspended particulate material is observed in study sites due to higher tidal amplitude in the Gulf of Kachch.

Levels of nitrite during the study period fluctuated widely. Nitrite values are ranged between 0.03 µg/L to 2.497 µg/L and shows positive correlation with TSS while nitrate values were ranged between 0.2 µg/L -22.5 µg/L. its shows correlation with Turbidity, TSS and Nitrite.

Inorganic Phosphate is also an important nutrient like nitrogen compounds in the primary production of the aquatic ecosystem. During study Phosphate is ranged between 0.4 µg/L to 7.5 µg/L. highest values was recorded during

Sanghi while lowest values were found at Mandvi. While highest average value was observed at Mundra. Seasonally higher phosphate values were recorded during monsoon months.

Bibliography

Adams, J.B., Bate, G.C., 1999. Growth and photosynthetic performance of Phragmites australis in estuarine waters: a field and experimental evaluation. Aquatic Botany 64, 359-367.

Cleorn, J.N., 1987. Turbidity as a control on phytoplankton biomass and productivity in esturies. Continental Shelf Research 7, 1367-1387.

De Souza, S.N., and Gupta, R.S. (1986). Variations of dissolved oxygen in Mandovi and Zuari estuaries. *Ind. J. Marine Sciences* 15: 67–71.

Ferreira, J.G., Wolff, W.J., Simas, T.C., Bricker, S.B., 2005. Does biodiversity of estuarine phytoplankton depend on hydrology? Ecological Modeling 187, 513-523.

Hilmer, T., Bate, G.C., 1990. Covariance analysis of chlorophyll distribution in the Sundays River estuary, Eastern Cape. South African Journal of Aquatic Sciences 16, 37-59.

Daly, K.L., Walker O Smith, Jr, (1993) Physical-Biological interactions influencing Marine Plankton Production, *Annu. Rev.Ecol.Syst.* 1993. 24:555-85

McLusky, D.S., 1971. Ecology of Estuaries. Heinmann Educational Books, London, ISBN 0 435 61600 5.

Mitra, A., Patra, K.C. and Panigrahy, R.C. (1990). Seasonal variations of some hydrographical parameters in tidal creek opening into the Bay of Bengal. *Mahasagar – Bull .Natn .Ins .Oceanogr.* 23(1): 55-62.

Nandan, S.B. and Abdul Azis, P.K., (1993). Fish and shell fish fauna of retting and non-retting zones of the Kadinamkulam Kayal, Kerala. *J. Indian Fish. Ass.*23: 35-43.

Neill, M., 2005.Amethod to determine which nutrient is limiting for plant growth in estuarine waters at any salinity. Marine Pollution Bulletin 50, 945-955.

Qasim, S.Z. (1977) Biological productivity of the indian ocean. *Indian J Mar. Sci.* 6,122-137.

SMT. HANSA MEHTA LIBRARY
The M. S. University of Baroda

Rajasegar, M. (2003). Physico-chemical characteristic of the velar estuary in relation to shrimp farming. *J. Envron. Biol.* 24:95-101.

Ramaraju, V.S., Sarma, V.V., Rao, N., T.V. and Vijayakumar. (1987). Variation of physico-chemical characteristics with tide in Visakhapatnam harbour waters, East Coast of India. *Indian J. Mar .Sci.* 16: 218-222.

Viswanathan P K., Pathak K.D. and Mehta I.; Socio economic and ecological benefits of mangrove plantation: a study of community base mangrove resto+A1ration activities in Gujarat. Gujarat Ecology Commission, Gandhinagar 128 p.

Zingde, M.D., Sharma, P. and Sabnis, M.M., 1985. Physico-chemical investigation in Auranga river. *Mahasagar.* 18: 307-321.

Zingde, M. D., Abidi, S.A.H., Sarma, P. and Rokade, M.A., 1987. Base water quality of Thailand I: Contributions in marine sciences. *Dr. S. Z. Qasim, Sixteenth Birthday Felicitation Volume.* pp 307–318.

Hitesh V

(Karolemi Hitesh K)

Candidate

(P.C. MANKODI)

Guide